I. SUMMARY AND CONCLUSIONS

The primary purpose of this project was to collect and assemble data pertaining to hydrologic, hydraulic, geologic and morphologic factors which relate to the Mississippi River downstream from Alton, Illinois and to present them in a format which would be amenable to detailed analysis at a future time. Except for selected comparisons, analysis of the data was beyond the scope of work.

Hydrologic data are presented in a variety of graphical and tabular formats. Formats were selected such that stage, flow, precipitation, and precipitation-runoff relationships could easily be analyzed for both spatial (according to position in the basin) and temporal comparisons.

Vertical velocity distributions in cross sections at St. Louis and Chester during 1935 and 1973 apparently do not follow the Prandtl-von Karman universal velocity distribution law. This may be a source of error in comparisons of discharges made by different flow-measurement techniques.

In overbank areas near Vicksburg, relationships between river stage and overbank flow rates are well defined. There are no discernible depth-velocity relationships in the same overbank areas.

In the St. Louis district during the period from the late 1800's to the present, the specific effect of levees on scour and deposition on the overbank is indistinguishable from effects of other influencing factors.

There have been no discernible trends in water-surface-profile changes in the Middle Mississippi Reach since 1967.

In the St. Louis Reach, there has been an average bank-width reduction of about 29 percent (3320 feet to 2370 feet) since 1908. This reduction appears to be in response to dike construction. In the Memphis and Vicksburg Reaches, there is no apparent association between average bank width and dike construction.

Occurrences of overbank flow of sufficient magnitude to evaluate the possible influence of levees on stage-discharge relationships were too few.

At Hermann, Missouri, channel conveyance continually decreased from 1930 to 1973 as is reflected by increases in stage of about 2 feet to 3.5 feet for flows ranging from 64,700 cfs to 337,000 cfs, respectively.

For the period, 1881-1934, at St. Louis, stages for flows between 280,900 cfs and 501,300 cfs appear to have increased while stages for flows less than 209,200 cfs appear to have decreased. However, in the period, 1934 to 1973, channel conveyance steadily increased as is reflected by a stage decrease of 1.4 feet or more for all flows less than 501,300 cfs. The trend of increasing channel conveyance began at a time approximately coincident with accelerated dike construction activity which was observed in the period, 1925 to 1940.

Channel conveyance at Chester, Illinois has not changed significantly since 1943.

At Thebes, Illinois, stages for flows between 481,000 cfs and 572,000 cfs did not change significantly from 1934 to 1962, but increased by about 2.5 feet in the period from 1962 to 1974. For the entire 1934 to 1974 period, stages for mid-range flows (about 220,000 cfs) remained essentially unchanged, while stages for flows between 87,000 cfs and 135,000 cfs decreased a total of about 3 feet. Similar stage-discharge patterns with respect to time are observed at Metropolis, Illinois, on the Ohio River. Backwater from the Ohio River occasionally influences flows in the Mississippi River at Thebes. Therefore, it appears that factors which change stage-discharge relationships in the lower Ohio River may affect stage-discharge relationships in the Mississippi River above their confluence, and vice versa.

At Memphis, Tennessee, channel conveyance increased significantly during the period, 1933 to 1971, as is reflected by stage decreases of 3 feet and 6 feet for flows ranging from 1,070,000 cfs to 260,000 cfs, respectively.

At Vicksburg, Mississippi, channel conveyance increased during the period, 1931 to 1942, as is reflected by stage decreases of about 10 feet for flows of 1,340,000 cfs and less. This trend reversed in 1942 or 1943 so that by 1973 stages had increased by about 5 feet from the 1942 values.

There is no consistent pattern of association between either dike construction or average top-bank width and stage-discharge changes with respect to time. It appears that changes in stage-discharge relationships are primarily influenced by factors, as yet unidentified, in the close vicinity of the respective points of records. Therefore, stage-discharge relationships at any given station do not necessarily reflect conditions for any appreciable distance from the station.

Because of flood protection implications, it is recommended that causal factors relating to stage increases at Thebes and Vicksburg be investigated in detail.

Surficial soils adjacent to the river were classified and mapped through use of infrared color photography. This information is presented on coded overlays.

Lithology of the river bed is presented in cross-section format. Lithologic data were derived from reports of levee borings and borings associated with bridge construction. Data from borings in the channel are few. Due to variable nature of alluvial deposits, extrapolation of information obtained from borings on the floodplain to the channel has a low reliability in terms of precise interpretation.

Contour maps representing the bedrock surface and associated bluff geology have been prepared for the reach from Alton, Illinois to Cairo, Illinois. It appears that the valley is more deeply entrenched than was previously indicated (Fisk, 1944). Control points are too few to permit contouring of the bedrock surface between Thebes Gorge and Cairo.

Morphology data are presented in formats designed to facilitate identification of changes in river features over time. Invert profiles show changes over a period of approximately 40 years for 5 irregularly spaced time intervals which were chosen on the basis of available data and occurrences which may have caused changes in the river morphology. Channel cross sections were prepared at intervals of about 30 miles throughout the study reach for the same approximate time periods chosen for the invert profiles. Changes in 1) bar and chute development, 2) meander pattern, 3) thalweg, and 4) energy dissipaters (within channel confines) are presented on overlays for time periods comparable to those used for profiles and cross sections. Energy dissipaters outside the channel during 1974 are also shown on an overlay.

The morphology overlays clearly show significant changes have occurred at various locations along the river in each of the various time intervals considered. Although no attempt was made to determine causal factors for the observed changes, it is clear that these data in this format will be useful for such an analysis.

Dike, revetment, and levee information was tabulated showing date of construction, location, construction history (including modifications), materials used, physical characteristics, and current operational status. Levee crevasses were also tabulated, showing date of breach, location, type of breach, flood stage, size and type of area flooded, damage incurred, and physical features of levee and breach. Although information in many cases was missing, these historical presentations are essentially complete.

Information collected, compiled, and presented in this study should prove useful in evaluation of past engineering activities and in anticipation of effects of future engineering activities. These data could readily be used in providing a current base line for the Mississippi River, in which case the data file should be kept updated and developed, particularly in areas where data deficiencies are noted.